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Turning sustainability into action: Explaining firms' sustainability efforts and their impact on firm performance

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ABSTRACT

This research seeks to shed more light on how manufacturing firms adjust their strategy according to the sustainability challenge. Strategic decisions are influenced by strategic long-term considerations, which take into account aspects that lie within firms' boundaries and beyond. Therefore, the first step of this paper is to operationalise the sustainability challenge by identifying relevant drivers for sustainability that firms are exposed to. Second, we develop a framework showing which dimensions affect decisions concerning a sustainability move and which dimensions are affected by these decisions. A sustainability move can contain initiatives emphasising the adoption of new manufacturing technologies, the development of new, sustainable products or the integration of green practices into the supply chain. Next to the influence of sustainability drivers, we explain firms' decisions concerning a sustainability move with past performance, firm size and current level of sustainability action. Depending on whether initiatives are led by strategic or ad-hoc decisions, firms have to explore new knowledge and/or exploit existing knowledge to realise competitive advantage. The goal of this research is to provide an explanation of how decisions of sustainability moves are motivated and which dimensions in the firm are affected by these moves.

1. Introduction

The sustainability challenge has increasingly become a key-item on the management agenda of manufacturing firms since global warming and the finiteness of important resources, for instance, have caused different stakeholder groups to adjust their expectations on firms. Wu and Pagell state that "the need for environmental protection and increasing demands for natural resources are forcing firms to reconsider their business models and restructure their supply chain operations" (Wu and Pagell 2011: 577). Growing interest in sustainability has been found in both academia and industry (Linton et al., 2007), especially in the cross-disciplinary field of green supply chain management (GSCM) defined as "integrating environmental concerns into the inter-organisational practices" (Sarkis et al., 2011: 3). From a firm's perspective, sustainability can be defined as meeting the needs of a firm's direct and indirect stakeholders without compromising its ability to meet the needs of future stakeholders (Dyllick and Hockerts, 2002). The notion of sustainability is rather broad in nature as it entails the three pillars of the triple bottom line, namely environmental, social and economic aspects (Hart and Milstein, 2003). We recognise the importance of the triple bottom line for manufacturing firms, however, we focus on the ecological aspect, which we refer to as sustainability in this article. While the focus rests on the ecological aspect, the economic aspect is assumed to be accounted for in any given activity that firms undertake as their main goal is to generate profits and to grow. In line with the notion that all three aspects are integrated in the triple bottom line (e.g., Dyllick and Hockerts, 2002; Hart and Milstein, 2003), the ecological aspect has an impact on the social aspect as well. For instance, successful measures to reduce emissions at a manufacturing site have a positive impact on the quality of life of the wider community in the neighbourhood. Vice versa, the social aspect (while it is regarded important in its own right) has only a limited impact on the ecological aspect. Therefore, this research does not focus on the social aspect explicitly but solely on the ecological aspect. The interrelations between the three pillars of the triple bottom line are not emphasised in this research. The dominant debate regarding the manufacturing industry's environmental footprint, the likelihood of this trend continuing as well as significant business opportunities that might arise for manufacturing firms (in the form of eco-efficiency and resulting cost-savings, for instance) are the reasons for this emphasis.

Developments in the sustainability arena have significant implications on the strategic decision-making process of the firm as the sustainability challenge requires the revision of current management practices. Managers have to take into account latest

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developments in the market context of the firm, assess the competences of the firm and anticipate further developments to define strategy (Schweiger et al., 1986; Iaquinto and Fredrickson, 1997; Ferrier, 2001). Especially manufacturing firms are affected as manufacturing processes are energy intensive and consume significant amounts of resources. Numerous papers investigated the relationship between environmental efforts of a firm and its effects on performance and found mixed results (e.g. Hart and Ahuja, 1996; Anstine, 2000; Jacobs et al., 2010). On the one hand, studies investigating the relationship between environmental efforts and financial performance, measured as stock market performance, predominantly found a positive relationship (Hart and Ahuja, 1996; Klassen and McLaughlin, 1996; Jacobs et al., 2010). On the other hand, studies focusing on the relationship between sustainability efforts and the consumers' willingness-to-pay (WTP) found no positive relationship (Anstine, 2000) or even a negative relationship (Luchs et al., 2010) meaning that consumers value sustainable products less than non-sustainable products. The literature on sustainability provides limited answers to the questions why certain firms adopt sustainability management practices while others do not and under which circumstances firms can realise competitive advantage by the adoption of sustainable practices (e.g., Delmas and Toffel, 2004; Etzion, 2007; Rivera-Camino, 2007). Our assumption is that the answer can be found in different dimensions that drive the development of the firm as well as different moderating effects like the past performance of the firm: Whether firms initiate a higher focus on sustainability is determined by past performance as past success results in greater strategic persistence even after radical changes in the market (Anstine, 2000). In contrast, unsatisfying performance leads to re-evaluation of past and current patterns of business and therefore provides motivation for strategic change (Lant et al., 1992; Ferrier, 2001). To the best of our knowledge, there is no descriptive model, which supports decision-making of firms facing a sustainability challenge by linking all relevant dimensions in a transparent way. So far, it is not clear how managers should handle the various ambiguous facets of the sustainability challenge in order to turn them into action. Furthermore, it is not clear how firms can control the relevant stock of knowledge, which is necessary to realise sustainable activities. Prior work on knowledge management has pointed out the importance of knowledge exploration and exploitation (e.g., March, 1991; Gupta et al., 2006; Jansen et al., 2006; Lichtenthaler and Lichtenthaler, 2009). Interestingly, the knowledge perspective has not been used so far to explain mixed results in the relationship between sustainability efforts and performance.

To address the illustrated gaps, we first show possible initiatives firms can engage in to address the sustainability challenge (i.e. product-, process- and supply-chain-related) and explain the decision-making within the firm with the literature on rational-comprehensive strategy development. In doing so, the topic of decision-making is analysed as a response to the sustainability challenge from a managerial perspective. Taking into account various drivers, management is ultimately responsible for the firm's sustainability decisions in order to maintain or increase competitive advantage. We use past performance, firm size and the current level of environmental action as moderators to explain differences in the level of sustainability efforts a firm undertakes. The construct "level of sustainability effort" is used to evaluate the volume of a sustainability move, the duration of the move, the complexity of the move, and the unpredictability of a move in sustainability issues in order to consolidate single decisions into an integrated construct. Following Ferrier's (2001) notion of "attack", we label actions or initiatives undertaken in order to address sustainability as "sustainability move". If looking at the business environment of a given industry, efforts to become more competitive can be understood as winning a campaign against relevant competitors. There is a risk that a competitor moves first, which provides that firm with the first mover advantage. By moving into the market environment with a new sustainability initiative, a firm forms the rules for the market environment and, when successful, forces competitors to follow the given direction. With a successful sustainability move, a firm has gained at least a temporary competitive advantage. Furthermore, we illustrate relevant knowledge-related capabilities of the firm to explain how the decisions regarding sustainability need to be implemented to generate competitive advantage. By doing so, we provide fundamental work for future research on sustainability to overcome shortcomings of today's results.

Thus, this study makes theoretical as well as managerial contributions. First, it operationalises the sustainability challenge by defining the relevant drivers of sustainability. By listing and explaining drivers holistically, we want to raise the awareness of practitioners and academics as to how they might be influenced by changing environmental characteristics. Decision makers typically have blind spots (Zajac and Bazerman, 1991), although literature suggests that decision comprehensiveness is related to performance (Atuahene-Gima and Li, 2004). By reducing those blind spots with regard to sustainability, we aim to convert managers' limited perceptions of the most salient sustainability drivers into a more objective perception that takes all drivers into account holistically.

Second, this paper provides an explanation of decision-making with emphasis on sustainability by resorting to the decision-making literature. We have not come across conceptual frameworks which comprehensively present relevant drivers of sustainability and indicate the link to the strategic decisions of manufacturing firms. Past performance, firm size and the current level of environmental action are crucial for decision-making and determine the outcome of such decisions (Lant et al., 1992; Audia et al., 2000; Ferrier, 2001), because the ability to execute certain strategic decisions is influenced by those factors. To implement the decisions, firms can take action that is of a strategic, radical nature with a long-term perspective. Otherwise, firms take an incremental approach and implement ad-hoc steps to improve current business processes with a rather short-term perspective. The knowledge perspective completes our explanatory framework. In order to implement sustainability efforts, firms have to explore and/or exploit knowledge, depending on the ad-hoc or strategic character of the action. Organisational knowledge reflects the view of how resources should be used in order for the firm to benefit (Smith et al., 2005).

2. Decision-making regarding sustainability

This paper aims to explain why certain firms engage in strategic initiatives in support of sustainability while others do not. We use the literature on strategic process research to explain the phenomena in strategic decision-making. Strategic decisions are defined as "important, in terms of the actions taken, the resources committed, or the precedents set" (Mintzberg et al., 1976: 246). Those decisions are "infrequent decisions made by the top leaders of an organisation that critically affect organisational health and survival" (Eisenhardt and Zbaracki 1992: 17). In our understanding, decisions on how to deal with the sustainability challenge have the characteristics of being strategic. Therefore, the literature on strategic decision-making as one aspect of strategic process research can explain why firms interpret drivers of sustainability differently and consequently start diverging strategic initiatives.

2.1. Strategic decision-making

Strategic decisions not only have a major impact on the future of a firm, they are also characterised by a high degree of complexity,

ambiguity, novelty and open-endedness (Mintzberg et al., 1976). These characteristics lead to the absence of a single right recommendation how to solve a strategic issue. Managers are forced "to draw inferences and assumptions about their organisations and environments from available information and then try to define and solve problems" (Schweiger et al., 1986: 51).

The way how those problems are solved is influenced by the past performance of the organisation. Past firm success creates reliance on past business models and routines and inhibits a firms' aptness for strategic change and renewal (Lant et al., 1992; Miller, 1993; Ferrier, 2001). Inertia, defined as the level of commitment to current strategy and the tendency to remain with the status quo (Huff et al., 1992) and political processes due to past success stifle innovation (Amatucci and Grant, 1993) and lead to a lock-in effect (Burgelman, 2002). Audia et al. (2000) revealed that past success results in increased confidence in the correctness of current strategies and less seeking of information, which are reasons for a greater strategic persistence even after radical environmental changes. In contrast, poor past performance gives reason to re-evaluate past and current patterns of business and therefore provides motivation for strategic change (Ferrier, 2001). Successful firms not only realise environmental change, they are able to link this change to corporate strategy and thus, continuously pursue organisational renewal (Barr et al., 1992). The market context of the firm influences corporate strategy (Lant et al., 1992; Iaquinto and Fredrickson, 1997; Ferrier, 2001) as reorientation following poor performance is more likely in a stable market (Lant et al., 1992). Market characteristics encompass industry volatility (Lant et al., 1992), stability (Iaquinto and Fredrickson, 1997), the intensity of competition (Ferrier, 2001) as well as market features, meaning a concentrated versus a dispersed market (Das and Van de Ven, 2000). The sustainability challenge is a relatively new phenomenon, which represents a market change with the potential to rearrange industry characteristics. For example, new firms are emerging in the automobile industry with an exclusive focus on electric transportation. In this case, the awareness of sustainability has offered new strategies to compete in this industry, an industry traditionally dominated by large legacy firms, where volatility and intensity of competition were relatively constant. That might change in the future as new players enter the market. Firms take product and market characteristics into account, when defining a product strategy to get their new product technology accepted by the market (Das and Van De Ven, 2000). Those characteristics are influenced by the drivers of sustainability, thus leading to a market pressure, which triggers new strategic initiatives.

2.2. Path dependency in decision-making

Teece et al. (1997) argue that path dependencies play an important role in a firm's choices about domains of competence and are a function of past choices. Firms follow a certain path of competence development and this path affects their stock of competences and their ability to perform certain activities not only in the present but also in the future (Teece et al., 1997). By contrast, Eisenhardt and Martin (2000) argue that paths are not entirely set by a firm's decisions and resulting history but can also be adjusted through fast learning mechanisms, practice, making mistakes and learning from specific experiences. In their distinction between moderately and highly dynamic ("high velocity") markets, Eisenhardt and Martin (2000) argue that existing knowledge might suffice to deal with the former but not with the latter when change becomes nonlinear and less predictable. This is when firms are less concerned with existing knowledge and experience and much more concerned with rapidly creating situation-specific new knowledge (Eisenhardt and Martin, 2000). In support of Eisenhardt and Martin's (2000) view, Zollo and Winter (2002) note that while a high level of prior experience in heterogeneous contexts has a positive impact on performance of following projects, strong learning mechanisms can enable firms to (quickly) accumulate the required knowledge which suggests a more flexible view on path dependencies. More specifically, Eisenhardt and Martin (2000) argue that, in the context of high velocity markets, the need for stable existing knowledge is replaced by a need for specific new knowledge created closer to the time. This newly created demand-driven knowledge might cause departure from the more linear path trajectory put forward by Teece et al. (1997). Firms' decisions are influenced by past decisions and the stock of acquired competencies (Teece et al., 1997). Learning mechanisms enable firms to overcome the limitations of current knowledge resources with regard to dynamic environments (Eisenhardt and Martin, 2000).

2.3. Towards a decision-making process to address the sustainability challenge

The concept of strategic decision-making explains why firms take different approaches to address the sustainability issue. In order to holistically analyse decision-making with emphasis on sustainability initiatives, several aspects have to be taken into account. First, the drivers pressurise firms to decide whether to adopt sustainability initiatives and if so, which initiatives this includes. A thorough understanding of the sustainability challenge and related exogenous and endogenous drivers it consists of is essential since it helps firms to decide which measures to take (Etzion, 2007; Rivera-Camino, 2007). However, sustainability not only represents a threat to firms but also an opportunity (DeSimone and Popoff, 2000; Machiba, 2010). In order to act more progressively with respect to sustainability, ecological issues need to be regarded optimistically as an opportunity for future business success rather than as a threat (Sharma, 2000).

Second, several issues regarding decision-making need to be examined. If a firm decides to engage in sustainability initiatives, the question is which initiative is best suited for an individual firm. Firms can adopt new manufacturing technologies to utilise fewer resources and to produce fewer emissions in the production process, develop new and "greener" products that consume fewer resources during the complete life cycle, or develop and implement sustainable practices throughout their supply chain. Whether those practices can be enforced or have to be jointly developed is affected by the distribution of power within the supply chain (Jassawalla and Sashittal, 2002). Firms' decisions to invest resources in various initiatives are influenced by management decisions they took in the past (Teece et al., 1997). Firms that have already built competences in the area of one of the potential sustainability initiatives will be more apt to pursue those actions. The amount of additional investment is higher in unknown fields of activity compared to areas where firms already have undertaken action and subsequently have acquired expertise, which lowers barriers of action. Furthermore, if a certain expertise already exists, the probability of success for the knowledge creation is higher than taking a Greenfield approach.

Third, the impact of decisions regarding sustainability on knowledge management needs to be assessed. Once a firm has decided to engage in sustainability initiatives, the required knowledge becomes an issue. Lichtenthaler and Lichtenthaler (2009) note that knowledge plays a key role regarding a firm's ability to drive technology development and the ability to derive a competitive advantage. This relates to manufacturing, product development and the supply chain. Knowledge is particularly important in the context of the sustainability challenge which represents fast-paced change and pressures that firms need to deal with (Sharma and Vredenburg, 1998; Huang and Shih, 2009). As various authors suggest, knowledge creation and

application are critical to address the dynamics of that challenge (e.g., Robinson et al., 2006; Ahmed, 2007; Laszlo and Laszlo, 2007; Huang and Shih, 2009; Melville, 2010).

3. Development of a conceptual framework

The sustainability challenge currently represents a major challenge which manufacturing units are concerned with. To guide manufacturing managers in decision-making, we derive a conceptual framework from the sustainability literature and the literature on new manufacturing technologies (see Fig. 1). There are two mechanisms why firms take action towards more sustainability. First, certain external influences such as mandatory legislation may impose pressure upon a firm to kick off sustainability initiatives to prevent disadvantages or penalties. Second, firms see a potential competitive advantage in the realisation of sustainability initiatives leading to a voluntary pursuit of sustainability efforts. The generation of new markets for sustainable products, or cost savings realised through reduced resource consumption within the manufacturing process are both examples for opportunities that arise in the context of the sustainability challenge, which can be used to gain competitive advantage. No matter whether it is because of market pressure or the capturing of opportunities, firms are forced to decide whether they want to take action as an adequate answer on the drivers of sustainability or not. As mentioned, process enhancements due to new manufacturing technologies, new, greener products or the application of green practices within the supply chain are three prominent ways we have identified in order to deal with sustainability.

Although we acknowledge that there are even more possibilities for firms to become more sustainable, we focus on these three items as various publications name them to be the most prominent solutions for manufacturing firms (e.g., Sharma and Henriques, 2005; Etzion, 2007; Linton et al., 2007). Furthermore, the areas of green operations, green-product design and closed-loop supply chains were the most dominant sustainability issues in operations management identified by a literature review of the first 50 issues of Production and Operations Management (Kleindorfer et al., 2005).

3.1. Drivers of sustainability

Sustainability drivers can be classified into two groups: exogenous (external) and endogenous (internal) drivers. The following paragraphs will introduce the drivers from literature grouped in these two categories:

3.1.1. Exogenous drivers

In line with stakeholder theory (Freeman, 1984; Donaldson and Preston, 1995), the following stakeholder clusters are regarded dominant for this work: (1) environmental regulation, (2) societal values and norms and (3) market drivers. Environmental policy and regulations issued by governments and supranational organisations are critical sustainability drivers which firms have to comply with unless they are prepared to risk legal consequences and negative effects on reputation and image (Porter and van der Linde, 1995; Carroll, 1999; Banerjee, 2001; Delmas and Toffel, 2004; Etzion, 2007). Banerjee (2001) suggests that regulatory requirements have a significant impact on firms' environmental approaches and in consequence on growth and profitability. According to Etzion (2007), regulation can take different forms: "It can dictate technologies that must be used, can stipulate specific environmental targets that must be achieved, can create economic frameworks for redistributing environmental costs and benefits and so on" (p. 651). In those instances when management bears personal liability for environmental violations, regulation appears to be a powerful driver (Sharma and Henriques, 2005).

Values and norms in society and resulting expectations held by interest groups represent an influence that firms need to be aware of (Bansal and Roth, 2000; Wade-Benzoni et al., 2002). Typical interest groups include NGOs, media, politics, local community groups, value-based networks and consumer organisations (Wheeler et al., 2003). In general, dynamic mechanisms can originate from values and norms held collectively by any group of stakeholders (Rivera-Camino, 2007). These mechanisms can cause public pressure and have considerably gained power in recent years (Wheeler et al., 2003). It is critical for manufacturing managers to be aware of these mechanisms and to attempt to benefit from them when engaging in sustainable manufacturing initiatives (Wheeler et al., 2003).

Market drivers shape the market context which individual manufacturing firms are exposed to (Rivera-Camino, 2007). Stakeholders playing a role in these mechanisms include consumers, suppliers, competitors and shareholders (Rivera-Camino, 2007). Based on certain values and norms, consumers can respond favourably to a firm's sustainability initiatives and innovation which creates demand and therefore is of highest importance (Delmas and Toffel, 2004; Rivera-Camino, 2007). Suppliers might

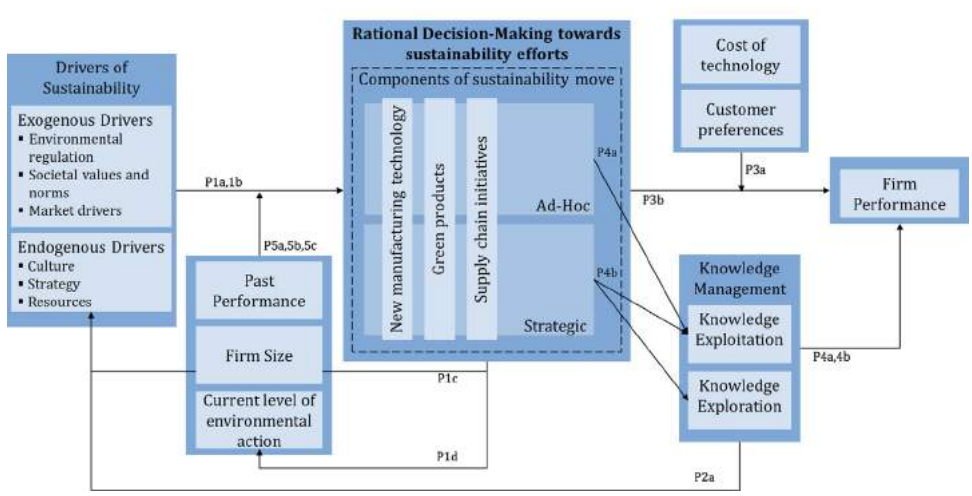

Fig. 1. Decision-making framework for firms in the context of sustainability drivers and potential outcomes.

discontinue to deliver inputs for fear of losing their own reputation, if the purchasing manufacturing firm is known for poor environmental practice in its processes (Rivera-Camino, 2007). A firm's competition might exert power in that competitors' values and norms may be perceived superior with regards to sustainability (Rivera-Camino, 2007). Investors can exert pressure as they can withdraw capital if a firm's specific risk is expected to rise due to poor environmental practices and a resulting damage to its image (Rivera-Camino, 2007).

3.1.2. Endogenous drivers

Endogenous drivers represent internal forces and include three groups: the manufacturing firm's (1) strategy, (2) culture and (3) resource base.

In order to enhance sustainability, a major challenge for managers is the degree of integration of sustainability principles (such as in the form of strategy objectives, vision and mission, for instance) into the overall firm strategy (Schaltegger and Burritt, 2000, Labuschagne et al., 2005; Etzion, 2007), which needs to include the integration of sustainability considerations in decision-making (Labuschagne et al., 2005). However, Etzion (2007) argues that organisations often tend to see sustainability as a separate aspect of core strategy. Labuschagne et al. (2005) regard this integration – which they refer to as "institutional sustainability" following the UN's "Agenda 21" – as a complementary fourth dimension to the three established dimensions of the triple bottom line aspects (e.g., Hart and Milstein, 2003). The authors note that this integration on the strategic level is a prerequisite for sustainable operations. Ramanathan et al. (2010) observe that in some cases firms have integrated sustainability considerations by simply adjusting their processes to meet regulations while others have taken a proactive role (i.e. self-regulation) and that the latter cohort of firms is more likely to succeed by introducing sustainable innovations to their processes. Laine (2005) discusses how the principles of sustainability can be better integrated into industrial activities. He suggests that win–win scenarios whereby economic and environmental benefits can be obtained at the same time support this integration. This notion implicitly hints at the concept of "eco-efficiency" (e.g., Desimone and Popoff, 2000) which allows firms to pursue sustainability (i.e. reduce energy and material consumption) while at the same time deriving economic benefits from these measures (i.e. reduced costs as a result). Russo and Fouts (1997) argue that a proper implementation of a sustainability strategy should become a driver for the development of human resources and organisational capabilities as organisational resources.

Cultural influences such as motivation, information dissemination, management commitment and a longer-term horizon represent important drivers of ecological responsiveness in manufacturing. First, Bansal and Roth (2000) revealed three major motivations that drive sustainability in manufacturing firms: competitiveness, legitimation and ecological responsibility. In addition, they identified three contextual conditions that lead to these particular motivations: field cohesion, issue salience and individual concern. Second, various authors have shown how accurate and timely information dissemination has a positive effect on the implementation of sustainability in manufacturing processes (Sharma et al., 1999; Lenox and King, 2004). Etzion (2007) sees a considerable potential for manufacturing managers to use a firm's information channels and networks to disseminate information in order to advance sustainability innovation in manufacturing. Third, manufacturing managers' commitment has a significant impact on how sustainability in manufacturing is approached. López-Gamero et al. (2009) argue that managers' environmental attitude is a significant factor in shaping their firm's sustainable orientation and innovation in manufacturing. Fourth, the time horizon is conducive to sustainability process initiatives (Schaltegger and Hasenmüller, 2005). According to Dyllick and Hockerts (2002), "an obsession with short-term profits is contrary to the spirit of sustainability" (p. 9).

The provision of adequate resources drives a firm's operations including sustainability initiatives. Barney (1991) assumes that in order to secure competitive advantage, a firm's resources should be valuable in exploiting opportunities, rare among competitors, imperfectly imitable as well as strategically non-substitutable. According to McGee et al. (1998), the resource-based view (RBV) is a useful concept in this case as ecological strategies and innovations tend to mature over longer periods which makes it more difficult for competitors to comprehend and then imitate these. Barney (1991) mentions physical capital resources including manufacturing technology and equipment as well as human capital resources as important factors for process innovation. Besides physical assets, certain skills and capabilities are part of the resources of the firm which influence the success of sustainability initiative implementation (Huang and Shih, 2009; Lichtenthaler and Lichtenthaler, 2009; Melville, 2010). Firms which have already obtained a track record in sustainability by gaining experience and important capabilities in sustainability management are better positioned to engage in further sustainability initiatives (e.g. Eisenhardt and Martin, 2000; Teece et al., 1997).

3.2. Decision-making towards sustainability

Strategic decision-making is complex, multilevel information processing and choices are emergent outcomes of that processing (Corner et al., 1994). Managers have to make assumptions about their organisations and their market from available information and then define an adequate strategy (Schweiger et al., 1986). By integrating the new phenomena of sustainability into strategy making, the strategic alternatives for firms have increased.

We adapt the notion of rational-comprehensive strategic decision-making (Eisenhardt and Zbaracki, 1992). Managers enter a decision-making situation with certain objectives and adapt their actions according to their goals. They acquire appropriate knowledge and information, develop different decision options and select the optimal alternative. The value of different decision alternatives is defined by its contribution to reach the predefined goals. Such a procedural rationality is defined as "the extent to which the decision process involves the collection of information relevant to the decision, and the reliance upon analysis of this information in making the choice" (Dean and Sharfman, 1993: 589). There is evidence that the rational-comprehensive decision process leads to more effective decisions (Dean and Sharfman, 1996), but the relationship is moderated by market dynamism (Hough and White, 2003).

To reduce uncertainty in decision-making, managers need profound knowledge of the drivers of sustainability. Rationality, defined as the extent to which a decision process involves the collection of information and analysis of this information, is positively related to decision effectiveness (Dean and Sharfman, 1996; Elbanna and Child, 2007). Accordingly, knowledge of sustainability drivers is a critical precondition for an appropriate decision process in our model. This process contains the phases of the identification of drivers, the development of alternatives and the selection (Mintzberg et al., 1976). These phases do not follow a causal sequence, but occur repeatedly in any order as cycling of different steps is necessary to revisit single parts of a choice when new information is available (Mintzberg et al., 1976; Eisenhardt and Zbaracki, 1992). The outcome of the decision-making process is a firms' future action towards more sustainability which, as a whole, defines the level of sustainability efforts. The sustainability

efforts of a firm reflect the degree to which firms engage in sustainability issues.

3.2.1. Components of a sustainability move

In order to make progress in terms of sustainability, firms can take different measures. In this regard, we identified three critical focus themes on the agenda of manufacturing firms that are encompassed by sustainability efforts: (1) new manufacturing technologies to make manufacturing processes more sustainable, (2) the development of green products and (3) the integration of green practices in the supply chain. We chose these areas of action as lean and green operations, green-product design and closed-loop supply chains were the most dominant issues in operations management on sustainability identified by a literature review (Kleindorfer et al., 2005).

The decision about sustainability initiatives on these three focus themes can be of an ad-hoc as well as a strategic nature, depending on whether a firm takes a more incremental or radical step. On the one hand, ad-hoc decision-making represents a reaction to pressures that need immediate attention (Winter, 2003). On the other hand, however, more radical changes call for strategic initiatives in sustainability management that focus on the longer-term. Dyllick and Hockerts (2002), for instance, argue that firms need to focus on longer-term goals and focus less on short-term benefits in order for sustainability initiatives to be successful. Similarly, Henderson and Cockburn (1994) as well as Schaltegger and Hasenmüller (2005) note that firms need to have a longer-term horizon in order for sustainability initiatives to work. Often, this strategic focus coincides with proactive approaches to sustainability (e.g., Delmas and Toffel, 2004; Etzion, 2007; Delmas and Toffel, 2008; Ramanathan et al., 2010). Firms that take a proactive role with regards to sustainability by going beyond what regulation expects, often succeed by introducing sustainability innovations and therefore gain competitive advantage (Rivera-Camino, 2007; Ramanathan et al., 2010).

The vast body of literature on New Manufacturing Technologies provides evidence that new manufacturing technologies and manufacturing programs are important for the success of manufacturing firms (Cua et al., 2001; Mora Monge et al., 2006; Sinha and Noble, 2008), but existing literature predominantly focuses on rationalisation and cost effects due to automation as well as increases in flexibility and quality. Udo and Ehie (1996) for example list 25 benefits of Advanced Manufacturing Technologies (AMT) including extensive literature sources and Small (1997) mentions 15 objectives for AMT implementation, both without taking sustainability into account. Kaebernick et al. (2003) state that "sustainability in the development and manufacture of new products is a strategy that is widely accepted in principle, although not yet widely practiced" (Kaebernick et al., 2003: 461).

Advanced Manufacturing Technologies have been regarded as valuable weapons to address the competitive challenges for global manufacturers including fragmented mass markets, shorter product life cycle and increased demand for customisation (Udo and Ehie, 1996). More recently, however, the topic of sustainability has increasingly become dominant as environmental pollution and resource scarcity raised public awareness especially for the sustainability challenge. This issue concerns various firm functions as consumer requirements are shifting and new products and business models are required that meet the needs of sustainable industrial systems. Due to high energy and water consumption as well as pollution rates and waste, manufacturing units are especially affected by the sustainability challenge. While generally, the positive impact of green management on financial performance is shown in literature (Molina-Azorin et al., 2009), only little empirical evidence exists, whether new manufacturing technologies in particular might be the suitable answer for manufacturers to address the sustainability challenge and generate superior performance (Klassen and Whybark, 1999; Pil and Rothenberg, 2003). Klassen and Whybark (1999) found that investments in environmental manufacturing technologies significantly affect both manufacturing and environmental performance. Thus, we argue that new manufacturing technologies are an important lever for firms engaging in sustainability management.

In terms of manufacturing technologies, sustainability enhancements can aim at the use of material and energy as well as the creation of emissions and waste (Rashid and Evans, 2009). We distinguish incremental ad-hoc initiatives from strategic manufacturing initiatives. Ad-hoc initiatives, such as the implementation of end-of-pipe technologies, aim to enhance existing manufacturing processes in order to increase resource efficiency and lower emissions. Strategic initiatives have a more radical, long-term character like the changeover of manufacturing capabilities to the ability of remanufacturing (Ijomah et al., 2007).

Measures to become more sustainable can be related to products as eco-efficiency is also relevant to produced goods. Desimone and Popoff (2000) argue that efficiency is not only applicable to increasing resource productivity in manufacturing but also to the creation of new goods and services that enlarge consumer value while maintaining or reducing environmental inputs. For instance, the Sustainable Product and Service Development (SPSD) approach seeks to support firms to make their products and services more sustainable throughout their entire life cycle including everything from conception to end of life (Maxwell and Van Der Vorst, 2003). More specifically, frameworks such as the Life Cycle Assessment (LCA) can guide firms to make products more sustainable overall. LCA can be defined as "a methodological framework for estimating and assessing the environmental impacts attributable to the life cycle of a product" (Rebitzer et al., 2004: 702). This includes the phases of production, use and end-of-life while the initial phase of design and development is ignored, because its environmental impact is often regarded insignificant (Rebitzer et al., 2004). Nevertheless, Rebitzer et al. (2004) highlight the potential of this phase to determine the environmental impact of the subsequent phases. Going beyond the "basic" LCA, Dreyer (2009) for instance, proposes environmental LCA. This specific type of LCA focuses in detail on the environmental impact of the product system by identifying all relevant processes and assessing their individual impact on the environment (Dreyer, 2009). The overall goal of such initiatives is to design and manufacture products that are not only environmentally friendly but also meet criteria such as functionality or cost-efficiency. An increasing number of firms introduce product-oriented environmental management systems and have introduced products with superior environmental performance (Boks, 2006). Literature also provides guidelines for firms to realise green product design. Kengpol and Boonkanit (2011) for example propose a decision framework helping firms to develop eco design in order to develop the new product more eco-effective than the baseline product.

As noted above, decisions regarding sustainable products can be of an ad-hoc as well as a strategic nature. An example of the former is an improvement in the fuel-efficiency of a conventional combustion engine. By contrast, an example of the radical long-term approach is an entirely new technology such as an alternative electric power train.

Sustainability considerations can be aimed at the supply chain as a whole. In order for the industrial system to be truly sustainable, it is not enough to look at a given firm and its processes in isolation (Etzion, 2007). For instance, Vachon and Klassen (2006) propose to extend green practices from the plant out into the supply chain, which affects numerous links among different stages

in the supply chain. This means that actors in the supply chain cooperate to minimise the environmental impact of the entire supply chain (Bowen et al., 2001) and build collaborative advantage rather than just competitive advantage (Vachon and Klassen, 2006). For example, suppliers and sourcing firms can jointly work out solutions and agree to use more environmentally-friendly modes of transport (i.e. shifting from road to railway transport). Ubeda et al. (2011) show how logistics can become green while simultaneously meeting the efficiency objectives. This can be achieved by a dedicated supply chain design which incorporates the application of new technological solutions. For instance, the use of sensor information to monitor environmental parameters such as temperature and shock gives indications on the condition of transported food stuff. This information can therefore assist players in the supply chain to save energy (by preventing unnecessary onward transportation if the goods have perished already) and time (by replacing perished food stuff sooner). By referring to the importance of the entire supply chain, we intend to put the topic of sustainability into the "wider" perspective which holistically takes into account environmental impact of different supply chain stages.

Again, decisions regarding sustainable supply chains can be of an ad-hoc as well as a strategic nature. For instance, an ad-hoc decision can be to update the truck fleet with more fuel-efficient models which can be accomplished in a short time frame. A longer-term strategic decision, for instance, can be to develop alternative logistical concepts involving more rail and sea transport versus road and air transport.

In our model, these three themes represent the components of a sustainability move which can all have both, a strategic or ad-hoc character. The model further reveals that each sustainability move changes the endogenous drivers in the sense that alterations in the technology base, the product base or the supply chain base have an influence on either, the firm's culture, its strategy, and/or its resources. This relationship should also be taken into consideration when decisions about changes in one of the three components of a sustainability move are made.

3.2.2. Characteristics of a sustainability move

A sustainability move has certain characteristics (move volume, move length, move complexity, move unpredictability). The more intensively these characteristics are addressed, the higher is the overall effort in a move. Therefore, the sustainability move itself is the sum of actions taken within the three characteristics. *Sustainability move volume* is defined as the number of sustainability actions a firm undertakes. The more firms engage in new, sustainable manufacturing technologies, green product design and GSCP, the higher the move volume. The *duration of a sustainability move* is the time elapsed from the beginning to the end of a sequence of sustainability actions (Ferrier, 2001). Firms that initiate and sustain moves (or attacks in the words of Ferrier, 2001) over longer, uninterrupted periods of time will be perceived as more aggressive (Ferrier, 2001). *Sustainability move complexity* is the extent to which sustainability efforts comprise different kinds of sustainability actions. Firms that are able to launch sustainability initiatives in breadth combine various ways to be perceived sustainable, thus leading to higher sustainability efforts. *Sustainability move unpredictability* is the variation of sustainability initiatives. Ferrier (2001) uses optimal matching analysis to measure unpredictability as "the extent to which a firm's sequence of actions carried out in a given time period was or was not similar to that carried out in the preceding time period" (Ferrier, 2001: 867).

The fact that a firm actively engages in various sustainability moves can initiate a feedback mechanism on its endogenous drivers. In cases when sustainability is tightly integrated in a firm's activities (Etzion, 2007; Schaltegger and Burritt, 2000) and when management truly supports sustainability (Etzion, 2007; López-Gamero et al., 2009; Melville, 2010), the positive impact on the firm's allocation of resources, its strategy as well as its overall corporate culture is particularly large. To highlight the importance of this point, Etzion (2007) notes that the disciplined implementation of activities in sustainability can drive the development of human resources and organisational capabilities (which can take the form of building a conducive culture or developing focused strategy processes, for instance).

After introducing our understanding of the exogenous and the endogenous drivers as well as sustainability efforts and resulting feedback mechanisms, we derive the following propositions for their relationship:

- Proposition 1a: An increase (decrease) of exogenous sustainability drivers causes a higher (lower) level of sustainability efforts.
- Proposition 1b: An increase (decrease) of endogenous sustainability drivers causes a higher (lower) level of sustainability efforts.
- Proposition 1c: Any sustainability move leads to an increase of one (or several) endogenous sustainability drivers.
- Proposition 1d: Any sustainability move leads to an increase of the moderating effect of current level of environmental actions between sustainability drivers and components of a sustainability move.

3.3. Knowledge management

To be able to execute a sustainability move, firms need to have a certain knowledge base. Especially if new (sustainability) challenges arise, firms need to build up new knowledge. If already existing requirements in terms of sustainability only get tighter (e.g., regulation on CO_2 emissions), already existing knowledge can be used and refined to address these new requirements.

Knowledge consists of information and know-how (Kogut and Zander, 1992; Helfat et al., 2007). Kogut and Zander (1992) refer to information as "knowledge which can be transmitted without loss of integrity once the syntactical rules required for deciphering it are known" (p. 386). Kogut and Zander (1992) note further that information is composed of facts, (axiomatic) propositions and symbols and that it is often proprietary. Know-how can be defined as the accumulation of skills that enables the work on and completion of a task in a smooth and efficient way (Von Hippel, 1988). Kogut and Zander (1992) emphasise the word accumulated implies know-how cannot simply be transferred as is the case with information but must be learned. More specifically for the organisational context, Smith et al. (2005) define organisational knowledge as "the validated understanding and beliefs in a firm about the relationships between the firm and the environment" (p. 347). Such organisational knowledge reflects the understanding of how resources should be used by the firm in order to benefit from it (Smith et al., 2005). Thus, a knowledge management capability has direct implications for overall firm performance. Garud and Nayyar (1994) argue that technology is a form of knowledge and consequently, technological change is related to knowledge development and learning. In general, knowledge is created through learning which Teece et al. (1997) attach high importance to. "Learning is a process by which repetition and experimentation enable tasks to be performed better and quicker" (Teece et al., 1997: 520).

In terms of knowledge management, exploration and exploitation are widely discussed in the literature (e.g., March, 1991; Henderson and Cockburn, 1994; Shane, 2000; Rosenkopf and Nerkar, 2001; Grant and Baden-Fuller, 2004). March (1991) refers

to the former as "exploration of new possibilities" and the latter as "exploitation of old certainties" (p. 71). In other words, exploration relates to knowledge creation which can also be regarded as learning while exploitation relates to knowledge application (Grant and Baden-Fuller, 2004). This is applicable to processes, products as well as the supply chain. March (1991) suggests that firms should address exploration and exploitation simultaneously and keep an appropriate balance of the two to overcome the limitations they have on their own. More specifically, exploration is only concerned with new knowledge for the firm, while exploitation focuses on the application of existing knowledge without creating anything new (March, 1991). Neither exploration which ignores the application of knowledge, nor exploitation which ignores the creation of new knowledge can create sustained performance alone (March, 1991). This suggests that the link between exploration and exploitation is critical (March, 1991). This link works both ways in that explored knowledge has to be exploited in order to benefit from it and that lessons learned from exploitation have implications on future exploration (because it is only beneficial for firms to explore knowledge that can eventually be exploited at some point).

Lichtenthaler and Lichtenthaler (2009) argue that a given set of knowledge and related capacities will likely help the firm to generate superior innovation performance as well as overall firm performance. However, the authors note further that while this might well hold for a given period, this is not the case for long periods. This means that certain knowledge capacities might support firms to generate performance in one period while this might not suffice to sustain that performance over time (Lichtenthaler and Lichtenthaler, 2009). To ensure sustained firm performance, firms have to take into account market dynamics (e.g., Eisenhardt and Martin, 2000) and engage in exploration and exploitation in order to adjust their knowledge base to meet changing market conditions (March, 1991, Lichtenthaler and Lichtenthaler, 2009). In other words, a firm's knowledge base needs to be adaptable in order to generate longer-term performance (Azadegan and Wagner, 2011; Helfat et al., 2007; Lichtenthaler and Lichtenthaler, 2009). Thus, we propose knowledge management capacities as an elementary mediating factor for two things: (1) for the realisation of superior firm performance (which will be discussed explicitly in the section below leading to Propositions 4a and 4b) and (2) for an increase of a firm's stock of knowledge and related resources. From this, we derive the following proposition:

- Proposition 2a: *An increase of knowledge management causes a higher level of resources*.

3.4. Firm performance

A large body of literature investigates the relationship between environmental management and performance. Mixed results were obtained suggesting that environmental efforts are a financial burden which hurts profitability or whether increases in efficiency and the development of new growth opportunities lead to higher profitability and competitive advantage (Hart and Ahuja, 1996; Klassen and Mclaughlin, 1996). Studies that dealt with the relationship between environmental management efforts and firm performance measured as the financial performance at the stock market revealed a positive relationship (Hart and Ahuja, 1996; Klassen and Mclaughlin, 1996; Jacobs et al., 2010), or found negative correlation between bad environmental performance and the intangible asset value of firm (Konar and Cohen, 2001). Rao and Holt, (2005) find that greening the different phases of the supply chain leads to increased competitiveness and better economic performance measured as new market opportunities, product price increase, profit margins, sales and market share. Furthermore, Green supply chain management (GSCM) not only leads to increased environmental performance, but also to superior economic performance (Zhu and Sarkis, 2004). Molina-Azorin et al. (2009) conducted a literature review of 32 studies that analyse the influence of environmental management on financial performance and found – although results were mixed – a predominance of studies providing evidence for a positive impact of green management on financial performance. Many authors investigated the effect of green management on operational performance. Klassen and Whybark (1999) found a positive effect between sustainable manufacturing technologies and manufacturing performance (cost, quality, delivery, flexibility). Environmental performance is complementary with lean manufacturing adoption (King and Lenox, 2001) and is a significant driver for superior quality (Pil and Rothenberg, 2003). Additionally, environmental excellence creates unexpected side benefits like waste reduction and efficiency gains in operations (Corbett and Klassen, 2006).

Other authors investigated the willingness-to-pay (WTP) of consumers for certain sustainable products. While studies in the agricultural sector (Misra et al., 1991) and the wood industry (Vlosky et al., 1999) found evidence for an increased WTP for environmentally friendly products, there is no such effect for the buyers of kitchen garbage bags that are made from recycled plastic (Anstine, 2000). These ambiguous results are explained by a study about the impact of product sustainability on consumer preferences (Luchs et al., 2010). The authors show sustainable product characteristics are not always perceived to lead to a better product. Although sustainability is regarded as positive, the presence of this characteristic can have "a negative effect on the perception of other product attributes. Consumers are aware that manufacturers operate under budgetary, product development, and manufacturing constraints" (Luchs et al., 2010: 19), thus assuming that the superiority of one product attribute was realised by a trade-off with the inferiority of other product attributes. This means that for product categories in which "strength-related attributes" are valued, consumers imply that sustainable products have the liability of inferior product performance. These findings might explain mixed results of studies on consumers' WTP for green products (Misra et al., 1991; Vlosky et al., 1999; Anstine, 2000) and for studies on the impact of environmental management on financial performance (Molina-Azorin et al., 2009). Thus, to investigate the relationship between sustainability efforts and performance, it is essential to control consumer preferences in a certain product market, as different industries are characterised by different product-related attributes. Another possible explanation can be found in the trade-off between additional costs for sustainability efforts and its benefits. While investments in sustainable manufacturing technologies for instance pay off to a certain degree due to higher efficiency and resource savings, this is only true until the additional costs exceed the realised marginal benefits. More efforts in sustainability do not lead per se to better performance, but only until a certain threshold is reached. Firms taking a very proactive approach in sustainability tend to overinvest in green initiatives going beyond the optimal effort-performance-rate. Those firms are characterised by an above average environmental performance for which the markets' acceptance and WTP is questionable. The costs of more sustainable technologies applied in processes and products are fundamental characteristics shaping the effort–performance relationship in our model. The costs of technology as well as the consumer preferences for sustainability are the major influencing factors whether an increase in sustainability efforts leads to an increase in firm performance. Hence, we propose the relationship between sustainability efforts and firm performance being a function of customers' and consumers' preferences and costs of technology following an inverted u-shaped curve. Sustainability effort pays off till a certain

threshold. Once the threshold is reached, further investments in sustainability initiatives are detrimental to firm performance. Based on these arguments regarding the relationship between a firm's efforts on sustainability and firm performance we propose the following:

- Proposition 3a: The relationship between sustainability efforts and firm performance is moderated by the combination of consumer preferences and costs of technology implementation.
- Proposition 3b: The relationship between sustainability efforts and firm performance is inverted u-shaped.

The model suggests that knowledge management takes different forms with ad-hoc and strategic approaches to improve business processes in the context of sustainability. The former approach is of a more incremental nature which is mediated by knowledge exploitation as existing knowledge is sufficient to fulfil shorter-term goals. However, the latter approach is of a more radical nature which is not only mediated by knowledge exploitation but also knowledge exploration. This is because existing knowledge is insufficient in some instances and needs to be complemented by newly created knowledge in order to be able to take into account newly arising and often game-changing challenges and thereby fulfil longer-term goals. Based on this discussion on sustainability move components, knowledge management and firm performance, the following propositions can be derived:

- Proposition 4a: The relationship between ad-hoc initiatives of sustainability efforts and firm performance is mediated by knowledge exploitation.
- Proposition 4b: The relationship between strategic initiatives of sustainability efforts and firm performance is mediated by knowledge exploration and exploitation.

3.5. Moderating effects

As we expect the relationship between drivers and decisions to be influenced by moderators, the following paragraphs will focus on possible moderators. Following the above-mentioned literature on strategic decision-making, past firm success influences the extent to which sustainability efforts occur as firms' aptness for strategic renewal towards sustainability and organisational inertia is affected (Huff et al., 1992; Lant et al., 1992; Miller, 1993; Ferrier, 2001). Those firms, which have already generated superior firm performance, will be reluctant to change their well-developed business model unless they experience urgency towards more sustainability (Lant et al., 1992; Miller, 1993). The reliance on existing business models and processes is bigger if firms made decisions in the past leading to success, because proven business practices increase the confidence and persistence in current patterns (Lant et al., 1992; Miller, 1993; Audia et al., 2000; Ferrier, 2001). In contrast, poor firm performance in the past will increase the probability that firms adapt their business model by incorporating sustainability practices (Lant et al., 1992; Miller, 1993; Ferrier, 2001). Firms which perform poorly or are at the brink of bankruptcy will be more willing to implement sustainability issues, as they exhibit a higher level of doubt and discussions of current business practices (Miller, 1993) and have less to lose. Poor past decisions leading to poor performance give reason to re-evaluate past and current patterns of business and therefore provides motivation for strategic change (Ferrier, 2001). This leads to a sense of urgency and makes them more likely to differentiate themselves from competition by establishing a sustainable firm identity. By doing so, firms compensate other weaknesses being the reason for their poor performance in order to become competitive. Thus, poor performing firms have a higher motivation to engage in sustainability resulting in higher sustainability efforts.

- Proposition 5a: Past performance negatively moderates the relationship between drivers of sustainability and sustainability efforts; as poor (good) past performance causes firms to be more (less) aggressive in their reaction to the presence of sustainability drivers.

The extent to which firms engage in sustainability initiatives is influenced by available resources needed for the implementation of new manufacturing technologies, the development of green products or the application of GSCM. Starting new strategic initiatives is resource intensive, not only financially, but also from a human resources point of view. Especially in smaller firms this can limit sustainability efforts as investments often have to be made in advance of new returns. This becomes even more important when several sustainability initiatives are made in parallel. Large firms possess the critical resources to pursue the invention of new products, GSCM and manufacturing process innovation simultaneously, while smaller firms have to focus on the most promising options. Thus, we propose that firm size moderates the relationship between drivers of sustainability and sustainability efforts as bigger firms can engage in higher numbers of sustainability initiatives with a higher duration of a sustainability move.

- Proposition 5b: Firm size positively moderates the relationship between drivers of sustainability and sustainability efforts; as big (small) firms respond more (less) to the presence of sustainability drivers.

The urgency and the willingness to initialise more sustainable actions are influenced by the current firm level of environmental action which is shaped by decisions in the past to engage in sustainability. In line with the notion of path dependency (e.g. Eisenhardt and Martin, 2000; Teece et al., 1997), the current level of environmental action reflects for example past investments in more sustainable technologies, green products and GSCM (King and Lenox, 2001; Pil and Rothenberg, 2003) and can be measured by the environmental performance of a firm. As outlined by Eisenhardt and Martin (2000) and Teece et al. (1997), past decisions to better take into account sustainability considerations and resulting investments influence future decisions and thus the future extent of environmental efforts. Firms with a low level of current environmental action will experience more pressure from sustainability drivers like regulation, customers and competitors than firms with a high level which already meet the required level of sustainability. Even firms with superior past performance, which are reluctant to change their way of making business, have to undertake additional steps towards a more sustainable way of doing business if their low level of current environmental action is not sufficient to meet pressures such as regulatory standards, thus forcing them to address actual sustainability issues.

- Proposition 5c: The current level of environmental action negatively moderates the relationship between drivers of sustainability and sustainability efforts; as firms with a low level (high level) respond more (less) to sustainability drivers.

4. Conclusion

In this paper we extend the understanding of decision-making in firms facing the sustainability challenge by providing an explanatory framework to guide future research on sustainability.

First, we give a comprehensive overview of exogenous and endogenous sustainability drivers to which firms are exposed. By providing a holistic summary, we establish a framework to operationalise the sustainability challenge for future empirical research. This will lead to a better understanding not only of the necessities for a firm to become more sustainable, but also of new opportunities like new markets for sustainable products or efficiency gains due to more sustainable, resource-efficient processes.

Second, we show possible initiatives for firms as a mean to address the sustainability challenge such as adopting new manufacturing technologies, bringing new, greener products to market, and introducing sustainability practices to the supply chain. We propose the construct of sustainability efforts reflecting the integrated actions of a firm to become more sustainable. By doing so, we provide a fundamental component for future work on sustainability from a firms' perspective to be established in the sustainability literature. Additionally, by defining actions and characteristics of a sustainability move we set the foundation to assess the magnitude of the sustainability efforts of a firm. Our framework allows the identification of those sustainability initiatives, which really lead to competitive advantage by integrating the impact of the chosen sustainability actions by firms on the performance dimension.

By integrating the knowledge management perspective as a mediator between sustainability efforts and firm performance into our framework, we accommodate the importance of knowledge-related capabilities. Knowledge capacities have to be aligned according to changing market requirements and market dynamics in order to mediate the creation of sustainable firm performance. Consumer preferences and other requirements to meet the sustainability challenge are new phenomena and not completely understood in every industry. Thus, we inaugurate the knowledge exploration capacities of a firm to develop such new knowledge and the knowledge exploitation capacities of a firm as a critical capability to apply knowledge in a firm's own products and processes. Both dimensions of knowledge management are inevitable to realise the benefits of superior firm performance due to actions towards more sustainability.

The paper furthermore connects the three main elements: (1) drivers, (2) decision categories, and (3) knowledge management dimensions, through propositions. By merging those literature streams, we extend the existing literature on sustainability, decision models, and knowledge management.

Various limitations of this paper merit discussion. First, we do not take any geographical differences into account. While geographical variations in productivity or legislation for instance are reflected by the occurrence of variable priorities within sustainability drivers, our model does not account for geographical differences in the relationship between sustainability efforts and firm performance. Lin and Chiang (2011) found country differences impacting the valuation of technology. In our context, this leads to country differences in adoption of new, more sustainable technologies as benefits of higher resource efficiency vary across countries. Consumers as well as political decision-makers in developed countries show higher awareness for sustainability compared to developing countries resulting in higher consumer preferences for sustainable products and processes and subsidies for sustainable operations. We expect the positive relationship between sustainability efforts and firm performance to be stronger in developed countries suggesting this proposition to be tested in future research. Therefore, the degree of generalisation of the findings might be limited.

Second, we acknowledge that there might be interconnections between certain drivers or various sustainability initiatives. For example, the introduction of new and greener products or the available information about more sustainable manufacturing processes might cause increased consumer awareness about sustainability. Thus, neither drivers, nor actions to be taken are fully independent from each other and endogeneity between sustainability drivers and firms' actions towards more sustainability might occur, which is not considered in our model.

Third, this paper does not differentiate the relevance of different drivers. Based on the literature we have argued that regulation and consumers are the most powerful drivers. However, empirical work is required to verify these findings taking the prevalence as well as the importance of sustainability drivers into account. For example, regulation might not be an issue at all in industries which take a very proactive approach regarding sustainability leading to firms being far ahead of laws and norms.

Fourth, our model does not take any marketing or communication efforts into account. A substantial benefit of sustainability initiatives is generated if consumers reward the efforts because of higher consumer preferences for sustainable products or supply chains. This leads to higher market shares or higher sales due to consumers' willingness to pay price premiums. A basic prerequisite is the public perceptions of a firm's green management efforts. Creating transparency and awareness is a function of a firms' ability to communicate with the market. Thus, the ability to communicate might serve as an additional mediator of the relationship between sustainability efforts and firm performance.

Finally, this paper is of conceptual nature. The propositions were not empirically tested so far. Further research should test the validity of propositions. In addition, further research should shed more light on the trade-off between extra investments in sustainability initiatives like new manufacturing technologies for instance and the positive impact on sustainability. Better understanding the threshold to which additional investments in sustainability are beneficial and under which circumstances costs of investment exceed expected benefits is a demanding task, which would be of tremendous interest for researchers as well as practitioners who have to justify investments (and related cost) in green initiatives. In line with this, there is a shortcoming in the literature on performance measurements related to the triple bottom line. In this piece of research, we only address financial performance measurements to evaluate the results of chosen initiatives. It would also be interesting to be able to evaluate changes in the three elements of the triple bottom line after conducting a sustainability move and how this is related to firm performance. The development of such performance measurements in relation to the triple bottom line might be worth further research and would help to justify sustainability moves.

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